

Household appliance and dispensing system for dispensing a fluid and an additive

The invention relates to a household appliance according to the pre-characterizing portion of claim 1 and to a dispensing system according to the pre-characterizing portion of claim 17.

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Such a household appliances and such a dispensing system are known from international patent application WO 99/27176.

Household appliances in which a fluid is dispensed exist in many varieties, for example in the form of irons with facilities for dispensing steam and/or water, hair dryers  
10 which dispense hot air, air humidifiers which dispense water and air, or toothbrushes which dispense toothpaste. The household appliance known from the aforementioned document is an iron for ironing textile. In this iron, the fluid dispenser for moistening textile before or during the ironing process comprises a water reservoir and an additive dosing system for adding an additive to the water, for example to improve the ironing of the textile or to  
15 provide it with a pleasant smell. The reservoir for containing the fluid is a water reservoir. The pumping means for pumping the water and additive from their respective reservoirs to a mixing chamber are situated between the water and additive reservoir and the nozzle. In one embodiment, a separate electric pump for pumping additive is provided in addition to the electric water pump. In another embodiment, a single pump pumps water and additive, and  
20 two capillaries and an adjustable valve control the concentration.

Although the separate pumps may enable an accurate and independent control of the respective water and additive flow rates, the use of two separate sets of pumping means also brings with it some disadvantages. For example, the application of two separate electric pumps means will add to the manufacturing cost and will make the appliance more  
25 bulky and more susceptible to mechanical failure. Furthermore, the appliance will be more complex to operate. In the second embodiment, an accurate control of the concentration is difficult to achieve because the pressure drop across the adjustable valve is relatively small and the viscosity of the additives may vary among additives and with the temperature of the additive. Furthermore, the capillaries and the adjustable valve form passages with very small

cross-sections across which small pressure drops are applied, so the passages can easily clog up.

5 It is an object of the invention to provide a solution wherein the above-mentioned drawbacks are avoided. To that end, a household appliance as claimed in claim 1 is provided. According to another aspect of the invention, this problem is solved by providing a dispensing system as claimed in claim 17.

10 By positioning the outlet of the additive reservoir such that additive will enter the conduit downstream of the pumping means, the dosing can be carried out in a section of the conduit where a substantial pressure is provided by the action of the pump, so that relatively predictable pressure conditions are obtained. Accordingly, the concentration can be controlled more reliably and the risk of clogging up is reduced. Furthermore, the concentration of additive in the dispensed fluid responds more quickly to changes in the  
15 additive supply rate when the additive supply is started, stopped, increased or decreased.

In order also to control the supply of additives, the pumping means preferably comprise first pumping means for pumping fluid from the supply means towards the dispensing nozzle and second pumping means for pumping additive from the additive reservoir into the conduit.

20 To pump additive from the reservoir towards the fluid conduit, the reservoir may be provided with a displaceable or deformable separation, such as a plunger or a membrane. On the side of the separation facing away from the outlet, pressurizing means may be provided for exerting a pressure on said separation, to force additive at the other side of the separation out of the reservoir.

25 An inlet passage is provided interconnecting the fluid dispensing system and a second compartment of the additive reservoir separated from a first compartment containing the additive by the aforementioned separation, so that fluid pressure from the dispensing system is guided into the reservoir and serves as pressurizing means. Consequently, only one pumping device is sufficient for pumping both the fluid to the dispensing nozzle and additive  
30 from the additive reservoir to the dispensing system. This results in a simple, compact, and low-cost dosing system. A particular advantage of this solution is that the pressure at which additive is being expelled is directly related to the pressure at which the fluid is fed. Hence, the more the pressure at which fluid is fed is increased, the more pressure is exerted for expelling additive. Consequently a very constant additive concentration is obtained.

It can be ensured in a simple manner that the pressure passed to the inlet is higher than the pressure at the position where the outlet meets the fluid conduit in that the inlet connecting the dispensing system to the first compartment is branched off from the conduit in a position between the first pumping means and the outlet

5           A desired pressure drop can be generated between the inlet and the outlet of the additive dosing system for driving additive supply in that a fluid flow restriction is provided in the conduit between the inlet and the outlet of the additive reservoir.

          Preferably, the fluid flow restriction is adjustable. This offers a user the option of influencing the pressure drop across the additive dosing system reservoir to regulate the additive concentration. Furthermore, the fluid flow restriction is preferably provided with a  
10           small leakage flow. Such a leakage flow ensures that, as long as no water is dispensed, the pressure drop across the fluid flow restriction, and thus across the additive reservoir, will decrease and preferably become zero. This will effectively stop any undesired additive flow.

          Inlet flow restriction means may be provided in the inlet, which connects the dispensing system to the additive reservoir. These inlet flow restriction means affect the  
15           pressure drop across the additive reservoir and hence offer an alternative possibility of regulating the flow rate of additive. Such a restriction does not suffer from the risk of clogging up due to caking of additives and from poor predictability due to varying additive flow properties.

20           The flow of additive towards the fluid conduit can be controlled very accurately when the outlet between the additive reservoir and the dispensing system is provided with an outlet flow restriction means. Since a substantial pressure drop is maintained across the outlet restriction, the risk of clogging up is very limited and the sensitivity to variations in flow characteristics of the additive is relatively small.

25           Preferably, the outlet restriction comprises an oscillating valve. This is particularly advantageous if the additive to be dosed is very concentrated, and very small doses are required to obtain and maintain a desired, constant mixing ratio. Since the cross-section in such a valve is varied constantly, the risk of clogging up and the influence of flow characteristics of the fluid are further reduced.

30           The activation of the outlet flow restriction may be synchronized with the operation of the first pumping means. Such a synchronization ensures that additive is only released when water is being dispensed. It furthermore allows for a very simple operation of the appliance, wherein, for maintaining a constant mixture of water and additive, a user can simply operate the pumping means.

The above and other advantageous embodiments of the invention are set forth in the dependent claims.

To explain the invention, embodiments of a household appliance will hereinafter be described by way of example with reference to the accompanying drawings, wherein:

Fig. 1 is a schematic view of a dispensing system according to a first embodiment of the invention;

Fig. 2 is a schematic side elevation view of a household appliance comprising a dispensing system according to Fig. 1;

Fig. 3 is a schematic view of a dispensing system according to a second embodiment of the invention;

Fig. 4 is a graph depicting the operation of a valve of the systems in Figs 3 and 5 in relation to operation of the pump; and

Fig. 5 is a schematic view of a dispensing system according to a third embodiment of the invention.

In this description, the same or corresponding parts are designated by mutually identical reference numerals.

Figs. 1 and 2 show a household appliance in the form of an iron 27 with an ironing sole 28, a handle 29, and a dispensing system 1 for dispensing a first fluid 2. In this example, the fluid is water. Another common fluid dispensable by irons is steam, which is usually dispensed via the ironing sole 28.

The dispensing system 1 comprises supply means comprising a reservoir 3 for containing the water 2 and a pump 8, a conduit 6, and a dispensing nozzle 5. The conduit 6 connects the reservoir 3 to the dispensing nozzle 5. The pump 8 is adapted for pumping the water 2 from the reservoir 3 towards the dispensing nozzle 5. The pump 8 may, for example, be a piston pump and may, for example, be driven manually or, as is shown in this example, electrically by means of a switch 9. When used in an iron, the water can be dispensed onto textile to be ironed, to help eliminating pleats and facilitate the ironing process.

The dispensing system 1 is provided with a dosing system 10, with which dosing system an additive 12 can be added to the water 2. When used in an iron, the additive

12 may, for example, be an additive for enhancing the ironing properties or the smell of the textile to be ironed. The dosing system 10 comprises a second reservoir 14 having a substantially cylindrical shape. The reservoir 14 is divided into an additive chamber 18 and a pressurizing chamber 16 by means of an axially moveable plunger 15. A removable lid 17 closes off an open top end of the reservoir 14. When the lid 17 is removed, additive 12 can be filled into the additive chamber 18. The additive is preferably a liquid. Compared with gases and vapors, liquids generally contain a relatively large amount of effective ingredients and can be handled relatively easily.

The reservoir 14 is connected in parallel to the dispensing system 1 by means of an inlet 20 and an outlet 22. The inlet 20 branches off from the conduit 6 downstream of the pump 8 and debouches into the pressurizing chamber 16 of the reservoir 14. The outlet 22 is connected to the additive chamber 18 and communicates with the conduit 6 in a position downstream of the position where the inlet 20 branches off from the conduit 6, preferably at a short distance (less than 2 to 4 cm) from the dispensing nozzle 5.

The dosing system 10 furthermore comprises a fluid flow restriction 24 and inlet flow restriction means 25 for controlling the flow rate of additive 12 into the dispensing system 1. The fluid flow restriction 24 comprises an adjustable one-way valve, mounted in the conduit 6 between the inlet 20 and the outlet 22. During operation of the pumping device 8, this fluid flow restriction 24 generates a pressure drop  $\Delta P$  between the inlet 20 and the outlet 22. The inlet flow restriction 25 also comprises an adjustable valve, in the inlet 20. With this inlet flow restriction 25, the flow of water 2 towards the pressurizing chamber 16 of the reservoir 14 can be regulated. Together, the pressure drop  $\Delta P$  and the flow rate of water 2 into the reservoir 14 determine the concentration of additive 12 injected into the water dispensed by the dispensing system 1.

The dosing system described above operates as follows. When a user activates the pump 8, an amount of water 2 is pumped from the reservoir 3 towards the dispensing nozzle 5. Part of the water 2 is pumped towards the pressurizing chamber 16 of the reservoir 14 through the inlet 20, due to the pressure drop  $\Delta P$  generated by the fluid flow restriction 24 and limited by the inlet flow restriction 25. A portion of the pressure drop is exerted on the plunger 15, which causes additive 12 in the additive chamber 18 to be moved into the outlet 22 towards the water conduit 6. The additive 12 entering the conduit 6 mixes with the water passing therein and is subsequently sprayed out via the dispensing nozzle 5.

The inlet flow restriction 25 enables a user to regulate the flow rate of water 2 towards the first compartment 16 and thus the flow rate of additive 12 urged to the dispensing

system 1. Preferably, the outlet 22 is provided with a conical spout 26 which is biased in the flow direction of the water 2 in the conduit 6, thus enabling a smooth, fluent transition of the additive upon 12 leaving the spout 26 and entering the water 2. Advantageously, the transition trajectory is designed such that some turbulence accompanied by a small pressure drop exists at or near the point where the additive 12 enters the water flow. The turbulence makes for a good mixing of the additive and the water.

By having the additive 12 enter the water 2 at a point near the dispensing nozzle 5, the risk of the subsequent mixture getting segregated before being dispensed is minimized.

Preferably, the one-way valve 24 allows a small leakage. This leakage ensures that the pressure difference  $\Delta P$  across the additive reservoir 14 will quickly return to zero after the pump 8 has been switched off, preventing an uncontrolled leakage of additive 12.

With a dispensing system described above, the water 2 and additive 12 can be pumped, first separately and later combined, towards the dispensing nozzle 5 with one single pump 8. Moreover, during the pumping the additive 12 will not contact the pump 8, which prevents the pump 8 from getting contaminated and prevents the additive 12 from being adversely affected by movements and pressures occurring in the pumping device 8. Furthermore, the dosage of additive 12 can be easily and accurately controlled by adjustment of the inlet flow restriction 25. Also, the additive dosage is related to the water supply pressure and thus to the amount of water being fed by the pump 8. Hence, fluctuations in the water supply will cause similar fluctuations in the supply of additive 12 to the water 2, as a result of which the overall composition of the fluid-additive mixture will remain very constant, without any need for the user to interfere.

Fig. 3 shows an alternative embodiment of a dosing system 10 according to the invention, in which an outlet flow restriction 30 is provided in the outlet 22 for regulating the flow rate of additive 12 towards the conduit 6. The inlet flow restriction means 25 illustrated in Fig. 1 are omitted. The outlet flow restriction 30 is provided in the form of an oscillating valve. Furthermore, a mixing chamber 32 is provided where the outlet 22 meets the conduit 6.

With the oscillating valve 30, the flow rate of additive 12 towards the conduit 6 can be very accurately controlled at a constant, desired value. This is advantageous, for example, if the additive is highly concentrated and small amounts of additive need to be dosed.

Preferably, the activation of the oscillating outlet flow restriction 30 is coupled to the operation of the pumping device 8 so that oscillation stops and the valve is closed when the pump 8 stops and oscillation starts when the pump starts, as is illustrated by Fig. 4. This ensures that no additive 12 gets spoiled once the pumping means 8 and the dispensing of water 2 are stopped.

The mixing chamber 32 allows the additive 12 and the fluid 2 to be mixed to a homogenous mixture, to be dispensed by the nozzle 5.

It is observed that providing the restriction in the inlet or the outlet is advantageous for preventing or at least reducing overdosage at start-up of the fluid flow.

When the fluid flow is started, the pressure build-up precedes the increase of the flow rate to equilibrium at the given pressure. Since the flow rate of the additive 12 is relatively low, the additive flow reaches a flow rate in the range of the flow rate during constant operation more quickly than does the fluid flow.

Fig. 5 shows a third embodiment of a dosing system 10 according to the invention, in which the driving means for driving the additive 12 out of the additive chamber 18 are formed by a spring 35 mounted on the side of the separation 15 facing away from the additive chamber 18. The spring co-operates with the plunger 15 in forcing additive 12 contained in the second compartment 18 towards the outlet 22 and into the conduit 6. As in the embodiment shown in Fig. 3, the flow restriction 30 is provided in the outlet 22 towards the water conduit 6. The outlet flow restriction 30 allows the outlet to be shut off completely when the pump 8 is inoperative, so the flow rate of additive can be stopped completely even in a situation in which the feeding pressure on the additive 12 is maintained even while the pump 8 is inoperative. As in the previously discussed embodiment, a mixing chamber 32 is provided for mixing the additive and the fluid before they are dispensed by the dispensing nozzle 5.

By using a spring 35 as the pressurizing means, a simple drive structure for driving additive to the conduit 6 is obtained. Moreover, all pumping capacity of the pump 8 is available for pumping the water 2 towards the dispensing nozzle 5.

The invention is not limited to the embodiments as described. For example, the flow restrictions may be embodied by other types of valves than those described above. When applied in an iron, the additive reservoir as well as the water supply means and in particular the fluid (water) reservoir may be disposed at least partly outside the iron. The additive may also be dosed into fluids other than water, for example into steam dispensed by

the iron, or into air. The appliance may be any appliance from which fluids are dispensed, such as hair dryers, air humidifiers, coffee makers, or toothbrushes.